Basic Knowledge
Wind Power

The success of modern wind power plants would be inconceivable without contributions from a wide variety of sub-disciplines. Condition Monitoring Systems (CMS) are becoming increasingly important for economic aspects in the operation of wind farms.

Aerodynamics

Aerodynamics is the science of the behaviour of bodies in a compressible gas (air). Aerodynamics describes the forces that make a windmill turn or that lift an aeroplane off the ground.

The design of a rotor blade for modern wind power plants has to take into account both the aerodynamic properties and the mechanical load-bearing capacity. Blade profiles which have been optimised in extensive simulations are often used in order to satisfy the requirements of large-scale wind power plants.

Energy conversion

In order to be able to use wind energy, the kinetic energy of the wind first has to be converted into rotational energy. The rotational energy can then be used in a generator to produce electrical energy. As with all energy conversion processes, losses have to be monitored in each separate step. Assuming the maximum usable wind power (the Betz limit), aerodynamic, mechanical and electrodynamic losses occur.

Gear technology

When transferring power from the rotor axis to the generator, two principle requirements must be met:

- good synchronisation properties with as little fluctuation in the speed and torques as possible
- good adaptation of the speed range between rotor and generator

Although considerable progress has been made in recent years in the development of frequency converters, established drive train designs are based on the use of transmission gearing. The gears make it possible to adjust the speed and/or frequency of the generator to the requirements of the alternating current grid.

Machine monitoring

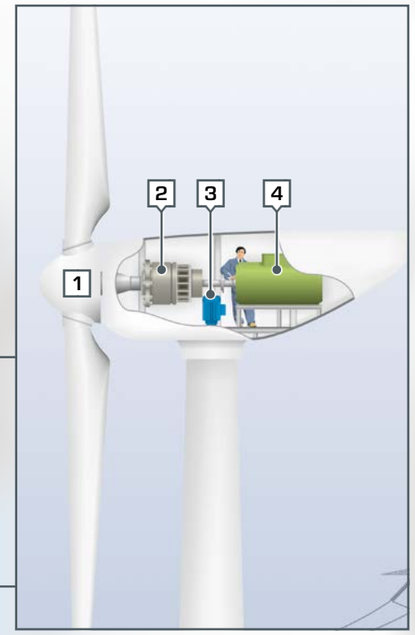
The construction and operation of a wind power plant go hand in hand with high investment costs. Failure of the rotor bearings, gears or rotor shaft leads to financial losses.

In order to avoid failure, wind power plants are continuously monitored by vibration analysis. The aim of these analyses is to detect and replace damaged components early, before the damage results in failure of the turbine.

Besides the rotor and the generator, wind power plants consist of lots of individual components which together form a functional and efficient wind power plant.

The following aspects play a key role in education specialist technicians and engineers in the field of wind energy engineering:

- functional principle and interaction of the individual components
- installation and operational monitoring

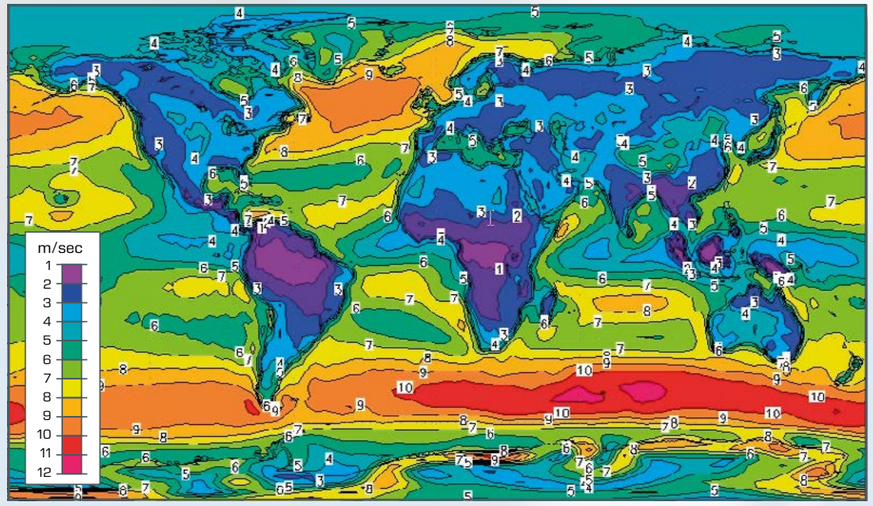


Wind power plant:

1 rotor
2 gearing
3 yaw motor
4 generator

Global wind energy supply

The graphic shows the average global wind energy supply as regions marked in colour



Subject Areas
Wind Power

Technology with a future

While traditional windmills have been widely used for hundreds of years for mechanical drives, generating electricity by means of large wind power plants is currently experiencing a breakthrough.

The current trend is heading towards large wind power plants with large rotors. This is mainly down to the fact that there are high wind speeds at high altitudes. Wind speed has a huge influence on the rotor's speed of rotation. Nowadays rotors with a diameter of 100 m are the norm.

The process of energy recovery through wind power includes extensive theoretical principles in addition to the practical aspects. Therefore, in our didactic concept on the field of wind power, we differentiate between the subject areas listed on the right.

Subject Areas	2E0 Products
Fundamentals of Wind Energy Engineering	
Investigations on flow around bodies	**HM 170** Open Wind Tunnel **HM 170.05** Drag Body Square Plate **HM 170.09** Drag Body Aerofoil NACA 0015 **HM 170.22** Pressure Distribution on an Aerofoil NACA 0015
Generating electricity from wind energy	**ET 220** Energy Conversion in a Wind Power Plant
How the real wind supply and electricity demand affect the yield from wind power plants	**ET 220.01** Wind Power Plant
Application Engineering in Wind Power Plants	
Energy transmission in gears	**AT 200** Determination of Gear Efficiency **GL 210** Dynamic Behaviour of Multi-Stage Spur Gears **GL 212** Dynamic Behaviour of Multi-Stage Planetary Gears
Machine monitoring	**PT 500** Machinery Diagnostic System, Base Unit **PT 500.11** Crack Detection in Rotating Shaft Kit **PT 500.12** Roller Bearing Faults Kit **PT 500.15** Damage to Gears Kit **PT 500.19** Electromechanical Vibrations Kit